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COMPENDIUM

OF
DENTAL RESIDENTS' RESEARCH PROJECTS
AND LITERATURE REVIEWS

1988



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USAF SCHOOL OF AEROSPACE MEDICINE
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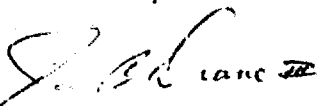
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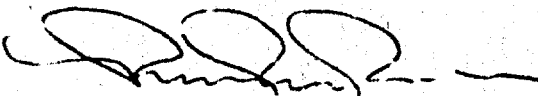
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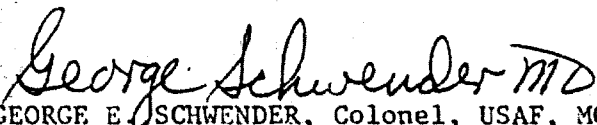
The animals involved in this study were procured, maintained, and used in accordance with the Animal Welfare Act and the "Guide for the Care and Use of Laboratory Animals" prepared by the Institute of Laboratory Animal Resources - National Research Council.

The Office of Public Affairs has reviewed this report, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nationals.

This report has been reviewed and is approved for publication.


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PREFACE

ABOUT THE COMPENDIUM

The Compendium of Dental Residents' Research Projects was recommended to the USAF Dental Education Committee in 1986 as a way to preserve the research efforts of U. S. Air Force dental residents.

This collection of abstracts provides a synopsis of research projects completed by graduates of United States Air Force residency programs. The projects were undertaken in partial fulfillment of the requirements of the training programs.

The opinions and assertions contained in the abstracts are those of the writers and are not to be construed as official, or as reflecting the views of the Department of the Air Force.

USING THE COMPENDIUM

The Table of Contents contains a numbering system to aid the reader in finding titles arranged according to discipline and year of presentation. The first two digits represent the year the thesis was written. The second two digits represent the specialty discipline:

- 9826 - General dentistry
- 9836 - Oral and maxillofacial surgery
- 9846 - Periodontics
- 9856 - Prosthodontics
- 9866 - Orthodontics
- 9876 - Oral pathology
- 9886 - Endodontics
- 9896 - Pedodontics

The last two digits are for our accounting.

The Table of Contents lists the title of the thesis followed by the name of the primary author and the page number where an abstract of the thesis may be found. The names of secondary authors are listed with the abstracts.

This year (and in subsequent years) we are providing a bibliography of previous titles. This section lists the titles according to the general category of their content. Within a category you'll find the titles listed alphabetically by author. If an abstract was provided in a previous edition of the Compendium, it will be in parentheses, as will be the year of publication.

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NO. 88 26 01

AN IN-VITRO STUDY OF THE MICROLEAKAGE OF THREE DENTINAL ADHESIVES

B. J. Lawrence, Lt Colonel, USAF, DC
J. O. Burgess, Colonel, USAF, DC
W. D. Theobald, Colonel, USAF, DC
J. W. Robbins, Colonel, USAF, DC

Microleakage of composite resin has resulted in limiting its use as a restorative material. This study examined the microleakage of three dentin bonding agents. Class Five cavity preparations were prepared and incrementally filled using the following bonding agents and composite resin: Tenure and Enamel Bond (Den Mat), Scotchbond and Silux (3M) and Universal Bond and Prisma Fil (Caulk). The teeth were thermocycled from 6-60° C for 500 cycles. All specimens were tested for microleakage either immediately after the 500th cycle or 3 months later. All areas except the margins were sealed with wax and fingernail polish; the specimens were placed in a 50% wt silver nitrate solution in darkness for 2 h. After rinsing and developing, the specimens were exposed to fluorescent light for 6 h and then sectioned to determine the degree of leakage. The microleakage of three bonding agents increased with storage time in water. Scotchbond exhibited the least leakage after three months.

NO. 88 26 02

APICAL MIGRATION OF BLEACH IN TEETH WITH IMMEDIATE AND DELAYED ROOT CANAL OBTURATION

G. C. Soulen, Lt Colonel, USAF, DC
H. J. Joyner, Colonel, USAF, DC
J. O. Burgess, Colonel, USAF, DC
R. D. Davis, Major, USAF, DC

Forty extracted human teeth were prepared and endodontically obturated with gutta percha and Grossman's formula sealer. Immediately after obturation a "walking" bleach with a methylene blue tracer was placed in the chambers of ten teeth. Dye without bleach was placed in ten immediate control teeth. One week after obturation, bleach and dye were sealed in the pulp chambers of ten more teeth. The final ten teeth acted as delayed controls and had bleach only sealed in the pulp chambers. All teeth were then sectioned and the degree of dye penetration was evaluated. No significant difference existed between the immediate and the delayed test groups. All groups displayed some degree of leakage.

88 26 03

SCANNING ELECTRON MICROSCOPE COMPARISON OF THE EFFECTS
OF VARIOUS IRRIGANTS IN ROOT CANAL DEBRIDEMENT

D. A. Clarke, Major, USAF, DC

The efficiency of various irrigating solutions for removal of inorganic and organic material has been studied by many investigators, often with contradictory findings. This scanning electron microscope study used a rank-ordered scoring system to statistically compare the amount of debris and smear layer remaining on the canal wall following root canal preparation. The four irrigating regimens were: 0.9% saline, 5.25% NaOCl, 5.25% NaOCl used alternately with 50% citric acid, and 3% H₂O₂ used alternately with 5.25% NaOCl. The NaOCl-citric acid combination had the lowest (best) cumulative scores for both residual debris and smear layer. However, statistical analysis using the Mann-Whitney U test revealed that the regimen using citric acid was not significantly better than NaOCl used alone. Although the smear layer seems to be a useful tool to evaluate canal cleanliness, further study is needed to determine its clinical significance.

88 26 04

HISTOLOGICAL EVALUATION OF THE PULPAL RESPONSE IN DOGS TO
PREPARING TEETH ANESTHETIZED BY THE PERIODONTAL LIGAMENT INJECTION

T. J. Plamondon, Major, USAF, DC

The purpose of this study was to histologically evaluate the response of dog pulps to the additive effects of tooth preparation after Periodontal Ligament (PDL) Injection of anesthetic containing a vasoconstrictor. Thirteen random source dogs provided 54 experimental and 50 control teeth. Some controls received a PDL injection only. Other controls had no injection but were prepared and filled. Experimental teeth received both a PDL injection and a traumatic tooth preparation and filling. Teeth were surgically removed at one and eighteen weeks and prepared for histologic evaluation. Results indicated that, in this model, there was little additive effect to the pulpal reaction due to the PDL injection. Prepared control teeth had essentially the same pulpal response as did the experimental teeth (PDL injection/preparation).

88 26 05

HISTOLOGIC SURVEY OF THE FRENA OF THE ORAL CAVITY

R. O. Ross, Major, USAF, DC

The literature shows an apparent lack of agreement concerning the histologic morphology of the frena of the oral cavity, particularly relating to the presence or absence of skeletal or striated muscle. The purpose of this study was to do a histologic retrospective analysis of forty oral frenal biopsy specimens. The result of the study showed that approximately 37.5% of the frena investigated contained skeletal or striated muscle.

88 26 06

PERIODONTAL DRESSINGS: DO THEY SUPPORT THE GROWTH OF PERIODONTAL PATHOGENS?

R. L. Eckles, Major, USAF, DC

Twenty-one patients treated surgically for periodontitis by flap procedures received "Coe-Pak" dressings. In 5-7 days the dressings were removed and the tissue side of the dressings (TS) and the oral environment side (OE) were cultured aerobically and anaerobically. There was no significant difference in types of bacteria found on either side of the dressing. The bacteria found were typical of bacteria normally present in the formation of plaque. The results of this study imply that "Coe-Pak" periodontal dressing does not promote the growth of putative periodontal pathogens when used for 5-7 days.

88 26 07

THE EFFECT OF THE PROPHY-JET ON BLOOD pH AND ELECTROLYTE CONCENTRATIONS

J. A. Snyder, Major, USAF, DC

J. T. McVay, Major, USAF, DC

The recent reemergence of air abrasive polishing as an adjunct to professional tooth cleaning has been accompanied by substantial research. Most of this research has focused on the efficacy of the Prophy-Jet and similar devices in the removal of plaque and stain, and on the effects of such devices on restorative materials and the various hard structures of the tooth. Little attention has been paid to the effects of mucosal absorption of the sodium bicarbonate in the polishing abrasive. The purpose of this study was to measure any changes in arterial blood chemistry with the use of the

Prophy-Jet. The pH values and the values for sodium and bicarbonate, as well as for other electrolytes, were measured in ten dogs over a 2 h period following a 5 min timed use of the Prophy-Jet. Of all the parameters examined, only the potassium concentration showed a statistically significant change, and the magnitude of this change was not felt to be clinically significant. The pH levels and the concentrations of sodium and bicarbonate remained essentially unchanged with the use of the Prophy-Jet. Based on these findings in dogs, the authors question the recommendation of the manufacturers to restrict the use of the Prophy-Jet for patients with respiratory illnesses or for those on a sodium restricted diet. Further studies in humans are needed.

88 26 08

FRACTURE RESISTANCE OF AMALGAM CORONAL-RADICULAR RESTORATIONS

J. J. Kane, Major, USAF, DC
J. O. Burgess, Colonel, USAF, DC
J. B. Summitt, Colonel, USAF, DC

This investigation examined the effects pulp chamber height and the extension of amalgam into the root canal space have on the fracture resistance of teeth restored with amalgam coronal-radicular restorations. Endodontic therapy was completed on 6 groups of 10 mandibular 1st and 2nd molars which were then mounted in acrylic 2 mm apical to the cemento-enamel junction (CEJ). The crowns of the teeth were ground occlusally until the height of the wall of the pulp chamber was 2 mm in Groups I and IV, 4 mm in Groups II and V and 6 mm in Groups III and VI. For Groups I-III gutta percha was removed 4 mm down 3 canals. Amalgam was extended into the root canals for Groups I-III and ended at the floor of the pulp chamber for Groups IV-VI. Dental amalgam (Dispersalloy, J&J) was mechanically condensed to a height of 7.5 mm coronal to the CEJ. A 45° bevel was placed on the buccal surface of the amalgam. One month later, using an Instron at a crosshead speed of 2 mm/min, force was applied to the bevel until failure occurred. Mean fracture loads (N) and SD were as follows: I:1711±364; II:1151±150; III:946±201; IV:1321±249; V:1303±357; VI:1132±415. Analysis of Variance (ANOVA) showed significant difference for the 3 pulp chamber heights studied ($p < .05$). Duncan multiple range analysis showed fracture load was only increased by extension of amalgam into the root canal space at the 2 mm (Group I vs Group IV, $p < .05$) but not at 4 or 6 mm pulp chamber heights. The mean of Group I was higher ($p < .05$) than that of any other group. This study supports the extension of amalgam into the root canal space only when less than 4 mm of pulp chamber height remains. Amalgam coronal-radicular restorations can be done with as little as 2 mm of pulp chamber height.

THE EFFECT OF AN ACUTE UNILATERAL OPEN BITE ON THE ADULT GOAT

J. C. Smith, Major, USAF, DC
 C. A. Bifano, Lt Colonel, USAF, DC
 R. B. Brannon, Colonel, USAF, DC
 W. Ehlers, DVM

Treatment for temporomandibular joint dysfunction (TMD) is frequently occlusally oriented, yet animal studies examining the effect of iatrogenic malocclusion on the temporomandibular joint (TMJ) give conflicting results. Explanation for these differences may include experimental design, small sample size, and different animal models. This study examines the effect of an iatrogenically induced acute open bite on the TMJ of the adult goat. Three groups of 18 animals were subjected to one of three treatments; unilateral occlusal reduction of all teeth by 3 mm, unilateral surgical impaction of the condyle by 3 mm, or a control surgical procedure with no occlusal alteration. Three groups of six animals were sacrificed at 6, 12, and 24 weeks. Outcome variables were measured at time of manipulation and at sacrifice, and included (1) Range of Motion (ROM); (2) Auscultation; (3) Radiology; (4) Weight/Health assessment. Gross morphology and histology were observed post-mortem. The results suggest a difference between treatment types for right ($p=0.00$) and left ($p=0.01$) rotation of mandible (ROM) and for maximum opening ($p=0.00$). The surgically altered group had the greatest hypomobility. The asymmetry in jaw movement seemed to change with time from a relative left hypermobility to neutrality. Joint noise was present in one animal preoperatively and in 11 animals post-op. No relation could be made as to treatment ($p=0.1$) or time ($p=0.4$). There were no identifiable changes between pre- and post-op transcranial radiographs. No gross defects were observed on joint examination. Histological effects were minor, suggesting remodeling rather than destruction. These effects were similar between groups. The results suggest that the TMJ of the adult goat is highly adaptable to gross alterations of occlusion, whether due to surgical impaction or occlusal reduction.

EVALUATION OF BOND STRENGTH OF SIX PORCELAIN FRACTURE REPAIR SYSTEMS

R. C. Pratt, Major, USAF, DC
 J. O. Burgess, Colonel, USAF, DC
 R. S. Schwartz, Major, USAF, DC
 J. H. Smith, Colonel, USAF, DC

Fracture of porcelain restorations is a common clinical problem. The expense and time involved in replacing an otherwise acceptable fixed prosthesis may make repair a viable alternative. This study compared the shear strength of six porcelain repair materials bonded to porcelain and evaluated the effect of thermocycling and aging. The six materials tested were: Porcelain Repair

Kit with Scotchprime Ceramic Primer (3M) (PR), Silanit (Vivadent) (S), Ultra-bond Porcelain Repair Resin (Den Mat) (U), Enamelite-500 (Lee Pharmaceuticals) (E), Ceram-Etch (Gresco Products Inc) (C), and Porcelain Repair Bonding System (Kerr) (PB). Twenty specimens were made for each product. Porcelain was baked on 15 mm circular metal-ceramic buttons and prepared to a 1 mm thickness. Each material tested was bonded to the prepared porcelain following the manufacturer's directions. After polymerization, specimens were placed in a 37° C water bath. Ten of each product were prepared for 48 h testing, and 10 were prepared for 3 month testing. Prior to testing, all specimens were thermocycled for 24 h. Specimens were tested for shear strength in an Instron machine with a crosshead speed of 2 mm/min. Mean shear bond strength at 48 hours in megapascals (MPa) was: PR-11.19, S-9.27, U-4.87, E-5.68, C-8.52, PB-11.29. Mean shear bond strength at 3 months (MPa) was: PR-6.19, S-2.14, U-2.98, E-2.32, C-1.42, PB-1.71. The data were subjected to a 2-way Analysis of Variance (ANOVA) which indicated a significant loss of shear bond strength, ($p < 0.001$), of porcelain repair products in that 3-month period.

88 26 11

MICROLEAKAGE AT THE AMALGAM-COMPOSITE INTERFACE

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J. O. Burgess, Colonel, USAF, DC
R. D. Davis, Major, USAF, DC
S. F. Robison, Colonel, USAF, DC

Proximity of caries to existing restorations in esthetic areas may require adjoining amalgam-composite restorations. Microleakage at the amalgam-composite interface is an important factor in the success of these restorations. Conflicting findings suggest that the order of insertion of the principal materials may affect the microleakage at the interface. The present study examined the relationship of microleakage to the order of insertion of the restorative components in restorations with amalgam-composite interfaces at various time intervals. Three restorations (two experimental and one control) were placed in 60 sound, extracted molars: (1) an amalgam control; (2) an amalgam-composite restoration where the amalgam was placed against a cured composite; and (3) an amalgam-composite restoration where the composite was placed against a set amalgam. In all restorations the amalgam was Tytin and the composite was Prisma-Fil. The teeth were then divided into three groups of 20. Each group was aged for either 1 week, 3 months, or 6 months. The samples were thermocycled for 24 h and stained with 2% basic fuchsin dye to demonstrate microleakage. Two raters evaluated dye penetration at the amalgam-composite junction according to the following scale: 0 = no leakage; 1 = leakage but less than 1/2 preparation depth; 2 = leakage more than 1/2 preparation depth, but not to the pulpal floor; 3 = leakage along the pulpal floor. Ridit analysis indicated the insertion order of composite against a set amalgam demonstrated less microleakage at 3 and 6 months than the insertion order of amalgam to set composite. There were no significant differences in microleakage at the composite to set amalgam interface and the control amalgam-tooth interface.

CYTOLOGIC VIABILITY OF ARTICULAR CARTILAGE CHONDROCYTES FOLLOWING DEATH IN ADULT GOATS

B. P. Graham, Lt Colonel, USAF, DC
C. A. Bifano, Lt Colonel, USAF, DC
B. W. Beck, Lt Colonel, USAF, DC

The purpose of this study was to compare the cytologic viability of chondrocytes harvested from articular cartilage containing joints of a goat model at time intervals post-mortem. Surgical technique called for harvesting articular cartilage samples from the rear leg joints (knee) and front leg joints (elbow) of eight healthy adult goats. Samples were collected from a rear joint before death, from a front joint 1 h post-mortem, a front joint 2 h post-mortem and a rear joint at 3 h post-mortem. The joint complexes were left intact until immediately before the harvest procedure. The animal was stored for the 3 h post-mortem at room temperature in a prone position with the legs upright. The cartilage samples were subjected to slow digestion to isolate chondrocytes by incubation at 37°C in Ham's F-12 with 0.1% collagenase for 24 h. Trypan-blue dye exclusion assay was used to measure cytologic viability of the isolated chondrocytes. A repeated measures analysis of variance of the data from the assay tests followed by paired t-tests found a statistical difference in viability between front leg and rear leg joints, ($p < .001$). No statistical difference was found, however, when comparing rear joint samples taken ante-mortem and 3 h post-mortem ($p > .25$) or front joint samples taken 1 h post- and 2 h post-mortem ($p > .96$). Chondrocytes from undisturbed goat articular cartilage joints may retain cytologic viability post somatic death.

OCCUSAL PENETRATION COMPARING ACID SOLUTION AND ACID GEL

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F. J. Foreman, Major, USAF, DC
J. O. Burgess, Colonel, USAF, DC
J. B. Summitt, Colonel, USAF, DC

Clinically, the viscosity of phosphoric acid gel etchants yields superior control during placement. However, this viscosity may impede penetration into occlusal fissures resulting in inadequate etching and a decrease in pit and fissure sealant retention. This study examined the penetration of gel and liquid phosphoric acid etchants in occlusal fissures. Twenty extracted, impacted mandibular third molars were sectioned into mesial and distal halves to control variation in fissure morphology. The paired samples were then cleaned with pumice and water. One half of the mesial group was randomly selected and treated with a 37% gel acid; the other half was treated with a

37% liquid acid. The distal group was handled in a similar manner. Penetration of the acids was evaluated using a scanning electron microscope. The etch pattern was measured from the base of the fissure to the first demonstrable evidence of etched enamel. Results of this study found evidence of etched enamel ranging from complete penetration into the fissure to no pattern observable at distances of 15 μ m. A frequent finding was debris partially or totally blocking the fissure orifice preventing acid penetration. Data was analyzed using a paired t-test. The findings of this investigation showed no statistically significant difference ($p < 0.05$) in the fissure penetration of gel or liquid phosphoric acid etchants.

88 26 14

AMALGAM REPAIR: AN IN-VITRO EVALUATION OF BOND INTEGRITY

E. O. Erkes, Major, USAF, DC
D. D. Hornbeck, Major, USAF, DC
J. O. Burgess, Colonel, USAF, DC
R. D. Davis, Major, USAF, DC

A number of clinical situations exist in which a dentist may consider repairing rather than replacing an existing amalgam restoration. In-vitro flexural strength determinations of repaired amalgam have had highly variable results. Jorgensen and Saito (Acta Odontol Scand 26:605, 1968) reported a flexural repair strength 90% that of unrepaired controls by first polishing the cut amalgam, and then burnishing a drop of Hg onto the surface to be repaired. The present study evaluated the effects of thermocycling and of various surface treatments on the flexural strength of repairs of a high copper palladium-content amalgam (Valiant Phd). Surface treatment consisted of 1 or 2 of the following: A-Surface polished with a 600 grit sandpaper disc; B-Surface roughened with a 556 crosscut bur; C-Surface burnished with a wet Hg-rich amalgam mix. Ninety amalgam specimens, 5 x 5 x 20 mm, were made. Ten served as the unrepaired controls. The remaining 80 were sectioned, and then divided into four groups. Each group received a different combination of the above surface treatments (A, B, & C). Group 1-A; Group 2-B; Group 3-A,C; and Group 4-B,C. Half the specimens in each group were thermocycled for 24 h between 6°C and 60°C (dwell time: 1 min). Fourteen days after repair, specimens were tested for flexural strength on the Instron. Data was analyzed by a 3-way Analysis of Variance (ANOVA) and the Duncan Multiple Range Test. Results: Mean flexural strengths of repairs ranged from 22% to 31% (130N-186N) that of unrepaired controls (598N). Thermocycling had no effect on repair strength. There was no significant difference between polished and roughened surfaces. The use of an Hg-rich increment did not improve repair strength.

TENSION BOND STRENGTH OF DENTAL ADHESIVES TO DENTIN AND ACID-ETCHED ENAMEL

D. J. Fasbinder, Major, USAF, DC
J. O. Burgess, Colonel, USAF, DC
W. D. Theobald, Colonel, USAF, DC

This study compared the tension bond strengths of one unfilled resin bonding agent and four proprietary dentin bonding agents to dentin and acid-etched enamel. The change in bond strength after thermocycling and water storage for 6 months was also evaluated. One hundred extracted human molar teeth were sectioned occlusally to expose dentin; the surface was wet ground with 320/400/600 grit silicon carbide paper. Another 100 teeth were flattened on the facial surface within enamel and finished in a similar manner. Enamel Bond/Silux (E), Universal Bond/Prismafil (U), Bondlite/Command (B), Scotchbond/Silux (S) and Tenure/Ultrabond (T) were each bonded to 10 teeth with prepared dentin surfaces and to 20 teeth with acid-etched enamel surfaces. All specimens were thermocycled for 24 h. Forty-eight hours later, 10 dentin bonded teeth and 10 enamel bonded teeth for each material were tested in tension in an Instron until bond failure. The remaining specimens were stored in a water bath at 37°C for six months and then tested in a similar manner.

	<u>D/48hrs</u>	<u>D/6mos</u>	<u>E/48hrs</u>	<u>E/6mos</u>	All values are in megapascals (MPa)
U	10.19 a	3.60 a	19.69 a	7.42 a	Statistical Analysis: Analysis of Variance (ANOVA) (p.001)
S	2.91 b	.56 bc	15.73 b	5.70 b	Duncan's Multiple Range Test (alpha=.05)
B	2.70 b	1.03 b	15.39 b	4.77 bc	
T	2.46 b	2.97 a	3.68 d	3.97 cd	a,b,c,d-denote significantly different bond strengths
E	1.32 b	.10 c	10.92 c	3.17 d	

All bonding agents, with the exception of Tenure, showed a significant decrease in tensile bond strength to both dentin and enamel after six months (p<.001).

ISOLATION AND CHARACTERIZATION OF CHICK EPIPHYSEAL CARTILAGE MATRIX VESICLE PROTEOLIPID

T. Cohen, Lt Colonel, USAF, DC

Membrane dependent calcification in bacteria involves dicyclohexylcarbodiimide (DCCD)-sensitive, ion translocating proteolipids. Since epiphyseal cartilage matrix vesicles (MV) appear to support calcification by a similar mechanism, this study was undertaken to determine the chemical composition and DCCD

binding characteristics of matrix vesicle proteolipids (MVP). The MV were prepared from the growth cartilages of broiler chick epiphyses (Ali et al, 1970). Specific activities of alkaline phosphatase and 5' nucleotidase were enriched in the matrix vesicles; ouabain sensitive Na/K ATPase was enriched in the plasma membranes. The MVP was isolated by organic solvent extraction with either $\text{CHCl}_3:\text{CH}_2\text{OH}$ 2:1 (MVP-1) or $\text{CHCl}_3:\text{CH}_2\text{OH}:\text{HCl}$ 200:100:1 (MVP-2), followed by Sephadex LH-20 column chromatography. Protein composition and ^{14}C -DCCD binding characteristics were determined by SDS-polyacrylamide gel electrophoresis and autoradiography. The MVP-1 contained a single W-shaped band at 6,000-8,000 Mr while MVP-2 exhibited bands at 4,000-5,000 Mr (MVP-2a) and 14,000-16,000 Mr. The MVP-1 and MVP-2a bound ^{14}C -DCCD in a dose dependent manner. Competitive binding with DCCD, the hydrophilic carbodiimide EDAC, and glycine ethyl ester, demonstrated that ^{14}C -DCCD binding was specific and to carboxyl groups in hydrophobic regions of the protein. Thus, MVPs differ in molecular weight and differential solubility from those isolated from calcifying bacteria. A subset of MVPs exhibit DCCD binding characteristics comparable to ion translocating proteolipids.

88 46 02

COMPARISON OF IN-VITRO MURINE MACROPHAGE ACTIVATION BY LIPOPOLYSACCHARIDES
FROM SELECTED BACTEROIDES GINGIVALIS STRAIN

R. Sabatini, Major, USAF, DC

Lipopolysaccharides (LPS) isolated from strains of Bacteroides gingivalis have been shown to elicit in-vitro bone resorption in organ culture systems. The finding of increased resorption in the presence of factors such as interleukin 1 (IL-1) and prostaglandin E2 (PGE2) suggests that LPS-induced resorption of alveolar bone may be a function of macrophage activation in the surrounding osseous and connective tissues. The purpose of this investigation was to compare the potential of LPS from B. gingivalis strains 33277, W50, and W83 for in-vitro stimulation of IL-1 and PGE2 production by murine peritoneal macrophages. Lipopolysaccharides fractions from the three strains were prepared using the methods of Darveau and Hancock (1983). The LPS preparations were added at concentrations of 1, 10, 50, and 100 $\mu\text{g}/\text{ml}$ to cultures of CD-1 murine peritoneal macrophages (5×10^5 cells/ml). Supernatants were collected at time 0 and at 24, 48, and 96 h for determination of extracellular IL-1 and PGE2 activity; IL-1 activity was measured as the potential of supernatant samples to stimulate uptake of (^3H)-thymidine by cultures of C3H/HEJ murine thymocytes. The PGE2 activity of macrophage supernatants was assessed using a competitive radioimmunoassay. The results indicate a dose dependent stimulation of IL-1 and PGE2 activity for each of the three LPS preparations tested. At concentrations of 50 and 100 $\mu\text{g}/\text{ml}$, PGE2 activity was similar for the three strains at all time periods tested. The IL-1 activity varied among the strains over the first 48 h but was similar after 96 h. Strain W50 consistently exhibited the greatest potential for stimulation of IL-1 activity, while W83 demonstrated higher PGE2 activity at most concentrations tested. The data implies that B. gingivalis pathogenicity may be a function of LPS-induced stimulation of IL-1 and PGE2 activity by macrophages, and that potential for such stimulation may vary among different strains.

A HISTOLOGIC AND SEM COMPARISON OF THE OSSEOUS INTERFACE IN LOADED IMZ AND INTEGRAL IMPLANTS

D. D. Gammage, Major, USAF, DC

The purpose of this study was to evaluate and compare the osseous-implant interface in loaded IMZ and Integral endosseous dental implants in dogs using light microscope histology, scanning electron microscopy and clinical parameters. Twelve weeks following extraction of the maxillary and mandibular left third and fourth premolars, two hydroxylapatite-coated Integral implants were placed in the maxilla and two flame-sprayed titanium IMZ implants were placed in the mandible. Sixteen weeks after placement, the implants were exposed and loaded with retrievable Rexillum III metal bridges. Plaque control was maintained using brushes and 0.12% chlorhexidine at weekly intervals. Documentation included gingival index (GI), probing depths, mobility, photographs and radiographs at monthly intervals. Four months after loading, the animals were sacrificed and block sections obtained and placed in Poly-SEM fixative. The undecalcified specimens were embedded in plastic and prepared for histology and SEM evaluation. All implants were clinically successful at sacrifice with minimal inflammation, probing depths 2-3 mm, no mobility, and no radiograph bone loss. Integral implants showed greater osseous adaptation at the osseous-implant interface in loaded conditions in dogs.

INITIAL BIOCHEMICAL CHARACTERIZATION OF CELLS DERIVED FROM HUMAN PERIODONTIUM AND THEIR IN-VITRO RESPONSE TO PLATELET-DERIVED GROWTH FACTOR

J. E. Piche, Major, USAF, DC

Little is known about the in-vitro characteristics of cells derived from human periodontal ligament/cementum. This study sought to investigate the characteristics of cells derived from the human periodontium. Cells were obtained from healthy human tissue using standard explant techniques. Two populations from the periodontal ligament/cementum (PL4 and PL7) were studied and compared to human gingival fibroblasts and alveolar bone cells. The PL4 cells and the bone cells had similar phenotypes. Both cell populations had CAMP levels enhanced by a 15 min incubation with parathyroid hormone (PTH) ($p < 0.001$), and high alkaline phosphatase levels which were significantly decreased ($p < 0.001$) by a 48 h incubation with PTH and elevated ($p < 0.001$) by a 48 h incubation with 1,25-dihydroxyvitamin D_3 . The PL7 cells and the gingival fibroblasts did not respond to PTH and had low basal alkaline phosphatase levels. When the proliferation of these cells was examined, both the PL4 cells and the bone cells proliferated in minimal essential medium (MEM) containing 4% platelet-poor plasma (PPP) and had enhanced proliferation in response to high (6.0 ng/ml), but not to low (0.6 ng/ml) concentrations of platelet-derived growth factor (PDGF). In contrast, the PL7 and the gingival

fibroblasts were quiescent in MEM containing 4% PPP and proliferated in response to low (0.6 ng/ml) and high (6.0 ng/ml) concentrations of PDGF. This study demonstrates that two different populations of cells can be obtained in-vitro from the periodontal ligament/cementum and that these populations can be distinguished biochemically and by their growth characteristics.

88 46 05

THE USE OF IONTOPHORETICALLY APPLIED ACYCLOVIR ON RECURRENT HERPES LABIALIS

L. G. Humphreys, Jr., Major, USAF, DC

A randomized, double-blind placebo controlled study was undertaken to determine the efficacy of iontophoretically applied acyclovir in the treatment of herpes simplex labialis. Participants in the study were otherwise healthy individuals who gave a history of at least three episodes of herpes labialis in the past twelve months. All "lesions" were treated within 24 h of onset. If a patient presented with multiple lesions, 1 lesion was left untreated and followed. Treatment consisted of a single iontophoretic application of acyclovir or the placebo, sodium bicarbonate. Healing of the lesions was monitored at several subsequent visits until complete. Clinical parameters analyzed included change in lesion size following treatment, time to the loss of lesion crust, and time to complete healing.

Statistical analysis revealed no differences among the groups when comparing initial lesion size and change in lesion size after 24 h. There was no difference in duration of healing between the acyclovir-treated lesions and the placebo-treated lesions. However, both acyclovir and the placebo demonstrated some efficacy when compared to untreated lesions. It appears that the iontophoretic application of acyclovir provides only limited clinical benefit in treating herpes labialis.

88 46 06

THE EFFICACY OF FLOW CYTOMETRY IN THE EVALUATION OF SPECIFIC BACTERIAL SPECIES WITHIN PLAQUE SAMPLES

V. W. Young, Major, USAF, DC

The purpose of this study was to refine the techniques by which the Fluorescence Activated Cell Sorter (Beckton-Dickenson FACS Star) can be used to screen specific organisms within plaque samples, comparing the results to fluorescent microscopy. Ethidium bromide stained Bacteroides gingivalis and 2 μ m fluorescent beads were counted at 1000 power with an oil immersion lens on the Petroff-Hauser counting chamber. The error of the method was less than 10%, which is within acceptable laboratory standards for microscopic counting. When each of these particles was viewed alone and in mixed proportions, it was shown that the FACS saw more particles by fluorescence than by light-scatter.

When known proportions of spheres and B. gingivalis were combined, the FACS saw less than 1% of the B. gingivalis expected by laboratory count. Another fluorescent DNA dye, Propidium Iodide, was then evaluated, as well as FITC staining of the cell membrane, to attempt to enhance the visibility of B. gingivalis to the FACS, but without success. When B. gingivalis was mixed into supragingival plaque samples and the sample stained with a fluorescent labeled antibody for B. gingivalis, detection by the FACS was possible when the organism was present at 0.1% of the sample volume.

88 46 07

IN-VITRO EVALUATION OF AN AIR-POWDER ABRASIVE SYSTEM FOR DENTAL IMPLANT MAINTENANCE

P. L. Parham, Jr., Major, USAF, DC

The purpose of this study was to evaluate the potential use of air-powder abrasive systems for the clinical maintenance of dental implants. Nineteen plasma-coated titanium dental implant specimens were divided into a sterile water-treated control group and an air-powder abrasive treated test group. All specimens were subjected to three different in-vitro testing modalities and evaluated by post-treatment scanning electron microscopy (SEM). The topographic character of the implant surface was determined before and after exposure to the abrasive. The biocompatibility of treated implant surfaces was also evaluated and compared, in-vitro, to nontreated controls. Finally, the attachment of a common oral microbe, Actinomyces viscosus, to the implant surface and its subsequent removal by exposure to the air-powder abrasive was examined. Results indicated that exposure of the implant specimens to the abrasive for varying periods resulted in slight rounding of the surface topography. Examination by SEM and statistical comparison of mean numbers of attached fibroblasts showed essentially equal distribution and attachment across specimen surfaces in both test and control groups. Comparative evaluation of test and control populations showed complete removal of bacteria from the specimen surfaces. Based on the results of this study, air-powder abrasive systems show promise as adjunctive instruments in the clinical maintenance of dental implants.

88 56 01

WEAR OF HUMAN ENAMEL AGAINST A CASTABLE CERAMIC RESTORATIVE

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G. B. Pelleu, Ph.D.
J. E. McKinney, Jr., B.S.

Because the hardness of castable ceramic (Dicor, Dentsply International, York, PA) is similar to that of tooth enamel, castable ceramic crowns may be

thought to produce only minimal wear in opposing teeth. The purpose of this study was to determine the effect of glazed and unglazed ceramic on enamel wear, using the wear produced by conventional dental porcelain as a control.

Cusp tips from extracted human third molars were precision machined into cones of enamel about 1 mm long. Nine cones each were abraded against rotating disks of glazed ceramic, unglazed ceramic, and dental porcelain. Enamel wear was calculated from microscopic measurements of the enamel cones before and after they were abraded. Mean and standard deviation values were 1.220 ± 0.218 for glazed ceramic, 0.639 ± 0.218 for unglazed ceramic, and 0.785 ± 0.311 for dental porcelain (all values are $\times 10^{-3} \text{ cm}^3$). Significant differences were found between glazed and unglazed ceramic and between porcelain and glazed ceramic ($p < 0.001$ Analysis of Variance (ANOVA), and 0.05 Scheffe's test). These findings suggest that castable ceramic should not be glazed in areas that will function against opposing teeth.

88 56 02

A COMPARISON OF TWO TESTS FOR DETERMINING THE CASTABILITY OF DENTAL ALLOYS

W. P. Naylor, Major, USAF, DC

Castability is an important characteristic of dental alloys, since casting completeness and detail reproduction have a direct bearing on the quality of dental restorations. The polyester mesh pattern, or Whitlock test, has gained increased popularity as a castability monitor. Therefore, this study compared castability values (Cv) in the Whitlock test with Cv obtained from measuring the amount of bevel reproduced in a coping pattern using five casting alloys and two investments.

The rank order and mean castability values for the five alloys in the Whitlock test with Ceramigold investment were: Rexillum III (100%), Naturelle (87.7%), W-1 (65.3%), Olympia (48.9%), and Forte (15.6%). For the Whitlock test with Vestra-fine investment, the results were: Rexillum III and W-1 (100%), Naturelle (99.4%), Olympia (85.8%), and Forte (25.0%).

For the coping test with Ceramigold investment, the rank order and castability values were: Naturelle (96.9%), Rexillum III (96.4%), Olympia (95.3%), W-1 (93.5%), and Forte (63.2%) with Ceramigold. For the coping test and Vestra-fine investment, the rank order and mean castability values were: Naturelle (97.8%), W-1 (95.9%), Forte (93.0%), Rexillum III (91.7%), and Olympia (88.2%).

The Whitlock test results did not parallel those of the coping test for all alloy-investment pairs as would be anticipated for a reliable castability monitor. In addition, the variability of the Whitlock castability values for some alloys was sufficient to question whether this test should be recommended for fine-tuning the casting process. In the interim, it may be more prudent to conduct castability studies with replica test patterns which more closely parallel the application of dental casting alloys.

COMPARISON OF MICROLEAKAGE OF COMPOSITE RESIN VENEERING SYSTEMS AT THE ALLOY INTERFACE

L. J. Blanco, Major, USAF, DC

The purpose of this investigation was to measure the amount of microleakage at the resin-alloy interface of three composite resin veneering materials and three new retention systems. One hundred twenty type IV gold alloy specimens 1 cm square and 0.5 mm thick were distributed in a 4 x 3 arrangement. There were 12 groups of 10 specimens each. Four methods of retention were used: Silicoater (Kulzer Co), Lee metal primer (Lee Pharmaceuticals), 4-META (Parkell), and microbeads (ESPE-Primer). These retention systems were used with three composite resins: Visio-gem (ESPE-Premier), Dentacolor (Kulzar Co) and Elcebond (Teledyne-Hanau). The retention and the composite resins were processed in cylindrical specimens, according to manufacturers' instructions, at the center of the gold alloy castings (4.85 mm diameter). These simulated restorations were thermocycled at 6-60°C for 2,136 cycles at 30 s dwell, immersed in a solution of 0.1 mCi of Ca^{45} for 2 h and sectioned with an Isomet diamond saw. The specimens were placed face down for 5 days on dental x-ray film for autoradiography. The resin-metal interfacial exposure on the dental film was measured with a Gaertner traveling microscope. All 4-META specimens separated during thermocycling and 60% separated during sectioning with the Isomet saw, rendering a population too small for statistical analysis. The results of the two-way Analysis of Variance (ANOVA) demonstrated significantly lower levels of microleakage for the Silicoater specimens than for those with microbeads ($p < 0.0001$).

THE INFLUENCE OF CONDENSATION METHODS ON POROSITY AND SHADE OF BODY PORCELAIN

D. B. Evans, Major, USAF, DC

This study compared four different condensation methods with four commercially available dental porcelains to determine whether the condensation method significantly influences apparent specific gravity (porosity) and/or shade of the porcelains. Ninety-six 12 x 12 mm high noble alloy metal substructures were randomly divided into four groups to receive the same shade of opaque and body porcelain from the following four different brands: Ceramco II G Series, Will-Ceram V-Series, Vita VMK 68, and Jelenko. The porcelains were applied to the metal squares in uniform thickness using four different condensation methods: (1) brush with vibration; (2) ultrasonic vibration; (3) spatulation; (4) no condensation. Following porcelain application, the apparent specific gravity of the body porcelain was calculated using buoyancy measurements. The porcelain shade was determined by analysis with a colorimeter. For clinical relevance, subjective observers made color comparisons. The

particle size distributions of the four porcelains were determined and plotted. No significant differences in apparent specific gravity (porosity) were found between methods of condensation within any of the four porcelain groups. The colorimeter results showed significant differences in two of the three color parameters between methods of condensation within each of the porcelains. Two porcelains displayed significant, subjectively-observed color differences between methods of condensation. Discriminations in particle size distributions could be graphically demonstrated in all four porcelains.

88 56 05

AN INVESTIGATION OF DENTAL LUTING CEMENT SOLUBILITY AS A FUNCTION OF THE MARGINAL GAP

M. S. Jacobs, Major, USAF, DC

The purpose of this study was to investigate the rate of luting cement solubility as it relates to the degree of marginal opening. Both a Diffusion Study and a Dynamic Study were used to evaluate cement dissolution. Test samples were made that would simulate marginal gaps and subsequent cement lines with the dimensions of 25, 50, 75, and 150 μm . Type 1 zinc phosphate cement was used as the luting agent. The post-dissolution results demonstrated that for the Diffusion Study there was no statistically significant differences in the remaining cement between the 25, 50, and 75 μm test groups. The 150 μm test group, however, demonstrated a small but statistically significant decrease in the area of remaining cement. Similar results were demonstrated for the test samples in the Dynamic Study. The rate of cement dissolution, however, for all test groups in the Dynamic Study was significantly increased when compared to the test groups in the Diffusion Study. During the Diffusion Study it was noted that the test samples exhibited two distinct layers of luting cement---a thin outer "halo" of cement which surrounded a larger unaffected core of cement. These layers of cement were separated and evaluated using x-ray diffraction techniques. The results demonstrated that zinc oxide was absent in the outer "halo" layer, suggesting that zinc oxide is one of the first constituents of zinc phosphate cement to be lost through dissolution.

88 56 06

THE EFFECT OF TEMPORARY CEMENTS ON THE MICROLEAKAGE OF CASTINGS LUTED WITH A PERMANENT CEMENT

M. T. Potter, Lt Colonel, USAF, DC

It has been suggested that temporary cements used with interim restorations before final placement of the cast restoration may have an adverse effect on the properties of the final cementing media. In this study, the relationship

of temporary cements, with and without eugenol, and the microleakage of cast gold restorations cemented with glass ionomer and zinc phosphate cements was evaluated.

One hundred extracted human third molars were prepared for cast Class V inlays to a standardized size. The teeth were separated into two groups to represent zinc phosphate and glass ionomer cements. These were subdivided into five sub-groups representing two temporary cements, a control, and two cleaning methods. The resulting 10 groups consisted of 10 teeth each. The teeth had cast gold restorations cemented temporarily with eugenol and non-eugenol containing cements. After 1 month, the restorations were removed, the teeth cleaned using one of two methods; then the restorations were recemented with glass ionomer and zinc phosphate cements. They were thermocycled and immersed in a Ca45 solution for 1 h. The teeth were embedded in resin and sectioned. Using autoradiography, the extent of microleakage was compared for each group. Data was statistically evaluated to suggest the relationship of temporary cements, tooth cleaning methods, and microleakage of cemented cast gold restorations. Editor's Note: No results were provided with this abstract.

88 56 07

ELECTROMYOGRAPHIC ACTIVITY OF THE JAW CLOSING MUSCLES DURING THE UNLOADING REFLEX IN PATIENTS WITH OSSEOINTEGRATED IMPLANT BRIDGES

R. C. Duncan, Capt, USAF, DC

The masticatory system has the potential to develop large impact forces during isometric muscle closure which, if inadequately unloaded, could compromise osseointegrated implant success. The purpose of this investigation was to determine if a decrease in intraoral sensory afferent discharge significantly altered the onset of the jaw unloading reflex. The use of latency rather than duration was based on the hypothesis that the mechanism for the silent period of the unloading reflex is due to a difference in decay of excitation and inhibition on levator muscle motor neurons. The unloading reflex was initiated on 30 subjects with a muscle unloading device connected to a single trace storage oscilloscope. The activity of the temporalis and masseter muscles was recorded with bipolar surface electrodes in a counter-balanced order. The interrater reliability for latency measurements was determined with a paired t-test; then a single blind investigation was used to measure all data. A one-way analysis of variance was used to compare the experimental groups. When the unloading reflex was measured in subjects with natural teeth, complete dentures, and implant supported prostheses, there were no statistically significant differences observed in the latency of the masseter or temporalis muscles ($p < .05$). The results describe monosynaptically appearing reflex characteristics and support the theory of autogenic inhibition as the masticatory load compensation mechanism. Therefore, the implant prosthesis can be biochemically designed in accordance with a normally functioning reflex latency.

THE INFLUENCE OF ACETYLSALICYCLIC ACID AND ACETAMINOPHEN
ON CLINICAL AND HISTOLOGIC ASPECTS OF ORTHODONTIC TOOTH MOVEMENT

C. E. Bedell, Major, USAF, DC

The extensive role that prostaglandins play in the cellular metabolism of living organisms is just beginning to be elucidated. Nearly all organ systems are in some way influenced by prostaglandins. Bone resorptive osteoclastic activity has been shown to have a connection to the biologic activity of this lipid family. The connection is as yet poorly understood, but has nevertheless led to possible clinical ramifications. Of particular interest in current orthodontic literature is the effect that prostaglandins have on the rate and quantity of tooth movement. High local concentrations of prostaglandins result in an increased rate and quantity of tooth movement. Prostaglandin inhibitors have the opposite effect. Utilizing 42 Hartley guinea pigs, two experimental groups and one control group were established to examine the effects that therapeutic doses of aspirin and acetaminophen, both prostaglandin synthesis inhibitors, have on clinical and histologic aspects of orthodontic tooth movement. Clinical and histologic results revealed no significant statistical differences between controls and either of the experimental groups. Given the influence that prostaglandins have on tooth movement, it seems reasonable to recommend against the use of prostaglandin inhibitors for the relief of orthodontic discomfort. However, the results of this study can justify no such recommendation.

STABILITY OF DOUBLE JAW SURGERY: COMPARISON OF RIGID
FIXATION VERSUS SKELETAL WIRE FIXATION

K. D. Satrom, Major, USAF, DC

Cephalometric head films from a sample of 35 patients who had undergone a LeFort I maxillary impaction combined with a simultaneous mandibular advancement were evaluated to determine the postsurgical stability of the skeletal segments. Twenty-six of the patients had rigid fixation to stabilize the segments and 9 patients had skeletal wire fixation. Twenty-seven cephalometric parameters were examined before surgery, immediately after surgery, and after a follow-up period averaging 15 months. The results showed the maxilla to be stable for both types of fixation, but the mandible was significantly ($p < .05$) more stable in the rigid fixation sample, especially in terms of the ability of rigid fixation to maintain rotational control between the proximal and distal segments. Measurements of cephalometric points representing resting muscle lengths indicated a propensity for the stretched muscles to relapse back to within 5 percent of their original lengths. Both groups showed a long-term change in the hyoid bone position and head posture.

AN IN-VITRO COMPARISON OF THE SEALING ABILITY OF MATERIALS
PLACED IN LATERAL ROOT PERFORATIONS

S. E. Dazey, Major, USAF, DC

Although the desirability of sealing an endodontic perforation is widely accepted, there is little data on how well repair materials actually seal. Perforation repair materials representing amalgam, a glass ionomer-amalgam combination, and calcium hydroxide in a visible-light-curing carrier were evaluated for their comparative sealing abilities. Extracted maxillary canines were cut into facial and palatal halves. After two perforations were made in the cervical and middle thirds of each root, they were repaired while the teeth were held in a mold simulating a periodontal ligament space. The teeth were coated with sticky wax, immersed in dye for 10 days, and longitudinally sectioned. Linear dye penetration was measured and the different groups statistically compared. The results indicate that Prisma VLC Dycal allowed significantly less leakage than either Tytin or Ketac-Silver. There was no difference between Tytin and Ketac-Silver which leaked the full extent of the repair. Although Prisma VLC Dycal sealed well in vitro, further studies must be undertaken in vivo before this technique can be recommended for patient care.

A COMPARISON OF LEAKAGE BETWEEN SILVER-GLASS
IONOMER CEMENT AND AMALGAM RETROFILLINGS

S. A. Schwartz, Major, USAF, DC

Apical microleakage following reverse fillings with zinc-free amalgam was compared to that using silver-glass ionomer cement. The root canals of 20 extracted human maxillary canine teeth were instrumented and obturated with laterally condensed gutta percha and sealer. Each root was then apically resected at a 45 degree angle to the long axis of the tooth. Following application of nail polish to the root surfaces, standardized apical cavity preparations were made. Ten of the cavity preparations were coated with cavity varnish and filled with zinc-free amalgam; the other 10 preparations were filled with silver-glass ionomer cement. After retrofilling, specimens were suspended in 2% methylene blue dye and placed into an incubator at 37° C for 7 days. The teeth were sectioned longitudinally, and the depth of linear dye penetration was measured. Dye penetration was significantly less ($P < 0.01$) in the specimen filled with silver-glass ionomer cement than in those filled with zinc-free amalgam and cavity varnish.

GENERAL PRACTICE RESIDENTS'
ARTICLES/LITERATURE REVIEWS

1. Bolling AFB/Lt Col Shannon E. Mills, Director

a. "Thrombotic Complications from Intravenous Sedation: Can They Be Prevented? A Review of the Literature." Jun 88, Terrence L. Hauck, Capt, USAF, DC.

b. "Localized Alveolitis 'Dry Socket' Etiology, Prevention, and Treatment," Jun 88, Michael P. Najera, Capt, USAF, DC.

c. "Resin-Retained Fixed Partial Dentures. 'An Overview of Retentive Mechanisms'," Jun 88, Robert J. Rung, Jr., Capt, USAF, DC.

d. "The Keyes Approach To Periodontal Therapy: How Valid?" Jun 88, Donald A. Vafides, Capt, USAF, DC.

2. Chanute AFB/Lt Col William P. Caldon, Director

a. "Implication of AIDS to Dental Care Providers," Jul 88, Patricia J. Weiss, Capt, USAF, DC.

b. "Single Cone, Vertical Condensation Technique," Jul 88, Karl L. Meyer, Capt, USAF, DC.

c. "Chlorhexadine in the USA," Jul 88, Michael Komoroski, Capt, USAF, DC.

d. "Review of the Resin Bonded, Acid-Etched Fixed Partial Denture with Emphasis on Preparation Design," Jul 88, James A. Wimsatt III, Capt, USAF, DC.

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